A study in the measurements of dogs’ body odor by using human olfactory senses

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We evaluated the body odor of five dogs using the Triangular Odor Bag Method. In order to observe the values of “dilution ratio to the detection threshold (D/T)” , a panel was used to measure odor samples captured from 9 to 31 days after shampooing. This allowed us to measure D/T values of 1, 5, 10, 20, 50, 100 and 200. Though the odor indexes \( [-10\log (D/T)] \) increased each day after shampooing, they plateaued after the 24th day. Odor index values, intensity, and acceptability were measured using five dogs’ odor samples 19 to 105 days after shampooing. A significant positive correlation was found between the days after shampooing and odor indexes \( (y = 0.19x + 1, r = 0.39, \text{NS}) \). On the other hand, although the odor index tended to become high when the acceptability became low, statistically significant correlation was not found between them \( (y = -0.02 x, r = -0.06, \text{NS}) \). In conclusion, we found that we could measure and evaluate the dog’s odor by using Triangular Odor Bag Method in this study.

1. Introduction

It is known from archaeological and molecular data that dogs have been domesticated for at least 12,000 years, and thus were the first domesticated animals\(^1,2\). Now, many people in Japan consider dogs as companions or members of the family. Recently, there have been many reports about the effect of animal assisted therapy (AAT) using dogs. For example, they have been used to enhance the social lives of elderly patients suffering from dementia and schizophrenia and improving their daily lives\(^3,4\). Children with developmental disorders exhibit a more playful mood, are more focused, and are more aware of their social environments when in the presence of a therapy dog\(^5\). For patients with spinal cord injury, contact with the animals reduces their stress, increases their self-esteem, and helps them express feelings\(^6\). In 1988, the National Institute of Health\(^7\) reported about the effect that companion animals such as dogs have on the elderly and children.

We have been conducting AAT using dogs with aged persons at nursing homes and with children at a community center\(^8\). While visiting, it is important that the dog’s odor isn’t unpleasant. Shampooing can remove the dog’s odor, but it is troublesome and time-consuming for the dogs and their handlers. When visiting medical and care giving facilities, the question of how long a dog can go without shampooing is basic, but very important research, however, such investigations on odor concentrations, intensities and acceptabilities have not been made.

In Japan, the most popular olfactory sensory test, the Triangular Odor Bag Method, was first developed by the Tokyo metropolitan government in 1972 \(^9,10\). This method was enacted as Environment Agency Notification No. 63 of Japan\(^11\) of the Offensive Odor Control Law in 1995. This is an air dilution method in which panels repeatedly sniff diluted odor in air bags and calculate the concentrations and the indexes from the values of dilution ratio to the detection threshold \( (D/T) \)^{12,13}. The objective of this study was to apply the Triangular Odor Bag Method to evaluate the dogs’ body odor.
2. Materials and methods

2.1 The examination of the D/T values and the panel selection

First, a panel was selected to examine the D/T values when a decrease in the correct-answer ratio could be observed. The changes of the D/T values were examined at 1, 5, 10, 20, 50, and 100 times dilution using Dog C's odor samples from 9, 18, 24, and 31 days after shampooing.

The selection of panel members was conducted using T&T olfactometer (Daichi Yakuhin Sangyo Ltd.). The selection test included six men (5 in their twenties, 1 in his forties) and eight women (5 in their twenties, 1 in her thirties, and 2 in their forties).

These initial tests were done in the College of Agriculture lecture room at Ibaraki University (temperature 17–25°C, Humidity 40–70%). The 5-2 method was used in this test.

2.2 Animals and the collection of dog's body odor samples

We used five dogs with different owners that were kept in different places (Table 1). An experimenter and a dog groomer shampooed them by wetting the whole body using warm water, and lathering up the dogs with shampoo (Zoic; Hertland Co., Ltd, Japan) using a washbowl. After massaging, we rinsed out the shampoo, towed them off and dried them.

We took each dog to a windless, shady place outdoors to collect body odor samples. Odors were gathered in 10L Flek-Sample bags quickly by moving the pump (Fleks pump DCI-NA type; Omi Odor Air Service Co. Ltd.) around the dogs' neck and back. We got the dogs accustomed to the pump sound beforehand so they would not be frightened. Dog C was used to examine the value of D/T.

The Triangular Odor Bag Method test was conducted using the dog's odor samples from each of the day after shampooing time intervals (Table 1). They will be referred to as the 19 day samples, etc.

2.3 Odor measurement method by olfaction

The Triangular Odor Bag Method was conducted in accordance with the standards set by the Ministry of the Environment in Japan (13). Details of the measurement procedure are identical to the method for environmental samples, as defined in the standards. Odor intensity was rated on a 5-point scale: 0, no odor; 1, definitely detectable; 2, slight; 3, easily noticeable; 4, strong. Odor acceptability was rated on a 7-point scale: -3, very unpleasant; -2, unpleasant; -1, a little unpleasant; 0, neutral; 1, a little pleasant; 2, pleasant; 3, very pleasant. These tests were conducted by six different panels.

2.4 Statistical analysis

The regression lines were calculated by the test of Pearson's correlation. The Smirnov-Grubbs test was carried out to eliminate outliers.

3. Result and Discussion

It took about five minutes to gather a dog's odor in a 10 L sample bag from the fur around the neck. We tried to collect the odor samples by holding the pump about 5 cm from the skin, but we couldn't get a good sample. Therefore, we thought that it may be necessary to make direct contact with their skin.

Odor measurement usually starts from ten times dilution, but we started from undiluted samples because of their low concentration. While examining the D/T (Table 2), the 9 day samples had the same accuracy ratio at one, five and ten times dilution. We thought that we didn't need to dilute it five times. The accuracy ratio of the 24 day sample was 1.0 when we diluted at 50 times. When we diluted at 100 times

### Table 1 The summary of five experimental dogs.

<table>
<thead>
<tr>
<th>Dogs</th>
<th>Days(^\text{1})</th>
<th>Age</th>
<th>Sex</th>
<th>variety</th>
<th>Keeping site</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>19</td>
<td>7 years</td>
<td>♂</td>
<td>Labrador Retriever</td>
<td>Indoors</td>
</tr>
<tr>
<td>B</td>
<td>36</td>
<td>3 years</td>
<td>♂</td>
<td>Mix</td>
<td>Indoors</td>
</tr>
<tr>
<td>C</td>
<td>71</td>
<td>6 months</td>
<td>♂</td>
<td>Mix</td>
<td>Indoors</td>
</tr>
<tr>
<td>D</td>
<td>100</td>
<td>6 years</td>
<td>♂</td>
<td>Mix</td>
<td>Outdoors</td>
</tr>
<tr>
<td>E</td>
<td>105</td>
<td>3 years</td>
<td>♂</td>
<td>Miniature Dachshund</td>
<td>Indoors</td>
</tr>
</tbody>
</table>

\(^{1)}\) The days after shampooing
Table 2 The accuracy ratio in Dog C’s odor by olfactometry.

<table>
<thead>
<tr>
<th>Days</th>
<th>Dilution ratio to detection threshold</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>9</td>
<td>1.00</td>
</tr>
<tr>
<td>18</td>
<td>0</td>
</tr>
<tr>
<td>24</td>
<td>1.00</td>
</tr>
<tr>
<td>31</td>
<td>1.00</td>
</tr>
</tbody>
</table>

The odor samples were diluted at the seven steps at each 1, 5, 10, 20, 50, 100 and 200 times. Days showed the days after shampooing in Dog C.

For 31 day samples, the accuracy ratio was 0.66 and it did not go below 0.58. Therefore, we determined that 1, 10, 20, 50, 100 and 200 times D/T were suitable for olfactory measurement. However, the accuracy ratio of the undiluted 18 day sample was not 1 but 0. One possible explanation is an error made by an assistant. Another reason could be the difficulty of making odorless air made the precision of judgment lower. These are important problems to be taken into account in the future.

Although the odor concentration and index for Dog C didn’t become high just a few days after shampooing, we found that the odor became stronger gradually (Fig. 1). In this case, we could measure the dog’s odor by the dilution ratio as mentioned above.

The olfactory measurement for Dog A, B, C, D and E was conducted by six panels. We found that there is a strong positive correlation between days elapsed after shampoo and odor index ($y = 0.19x$, $r = 0.89$, $p < 0.05$) (Fig. 2). In conclusion, we found that dog’s body odor generally became stronger as days passed after shampooing among different dogs. However, this relation was noted in just indoor breeds (Dog A, B, C and E). Even though Dog D was kept outdoors, index and concentration levels of 100 day’s sample were low, 3.9 and 2.5, respectively. These were lower than Dog A, B and C’s odor index (11.3, 7.5 and 15.7, respectively) and (13.4, 5.6 and 36.9, respectively) concentration. It is thought that seasonal change affected the dogs kept outside more than those kept inside. This may have influenced the dog’s metabolism and other physiological factors. Changes in outdoor temperature greatly affect molting, and the ultraviolet rays from sun sterilize and deodorize the dog’s body and fur. Therefore, we could expect that outdoor dogs will not have a stronger odor than indoor ones.

Fig. 1 Changes in the odor index with the day passed after shampooing.

Fig. 2 Relationship between the days after shampooing and the odor index.

A significant positive correlation was found ($y = 0.19x$, $r = 0.89$, $p < 0.05$). Five dogs’ data were shown. Dog D’s data was the outlier.

We used dogs of different breeds, ages, sex, hair color and hair length. Since there are many factors affecting body odors such as living environment, food, birth control, castration, etc., we would need to...
examine each situation even if all the dogs were kept indoors. Although a statistically significant correlation was not found between the odor index and intensity ($y = 0.09x + 1$, $r = 0.39$, NS) (Fig. 3), it was found that the dog’s odor could be perceived and evaluated by human olfactory senses.

On the other hand, although the odor index tended to become higher when the acceptability became low, statistically significant negative correlation was not found between them ($r = -0.06$, NS) (Fig. 4). This suggests that the dog’s odor itself was not always uncomfortable, and may have been because of the panel’s feelings towards dogs or their previous experience with a dog’s odor. If we conducted this test taking these things into account, the relationship between odor index and the acceptability would be different.

We could measure and evaluate the dog’s odor by using the Triangular Odor Bag Method in this study, and it was shown that the odor of dogs kept indoors became strong within a few days after shampooing. If we take the Offensive Odor Control Law of 1971 (Japan Environment Agency) into account, the values of odor intensity ranging from 2.5 to 3.5 would be considered the range for judging if an odor is offensive. This range corresponds to the odors of the 36 and 71 day samples (3 and 2.5, respectively). Since the dog’s odor intensity from the 19 day samples was 1.5, we should shampoo the dog about once a month.

In the future, when we study dog odor concentration and intensity, we must take the dog’s boarding conditions and the panel’s experience with dogs into account. Consequently, we will be able to decide a shampooing schedule that is suitable for visiting public places, facilities for elderly people, hospitals, and schools without worrying about the dog odor making anyone uncomfortable.

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Key words: dog; body odor; triangular odor bag method; shampooing

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4) Richenson, N. E.: Effects of animal-assisted therapy on agitated behaviors and social interactions of older
ヒトの嗅覚を用いたイヌの体臭測定の検討

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要旨：三点比較式臭袋法を用いたイヌの体臭測定について検討した。シャンプー後経過日数19日から105日までの5匹のイヌの匂いサンプルを用いて臭気指数、臭気強度および快・不快度について測定した。その結果、シャンプー後の経過日数と臭気指数の間に強い正の相関関係が認められた（r=0.89, p<0.05）か、臭気指数と臭気強度の間には統計学的に有意な相関関係（r=0.39, NS）は認められなかった。一方、臭気指数が高くなると快・不快度は低下する傾向がみられたが、両者間には、有意な負の相関関係は認められなかった（r=−0.06, NS）。以上より、三点比較式臭袋法を用いてイヌのにおいを測定および評価が可能であった。

キーワード：イヌ、体臭、三点比較式臭袋法、シャンプー

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